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EDITORIAL.

THE Committee organised by the Medical Research Council in conjunction with the Pathological Society of Great Britain and Ireland for a collective investigation on status lymphaticus has now issued its report. The final conclusion is that there is no evidence that so-called "status-thymico-lymphaticus" has any existence as a pathological entity. Nevertheless we are not abashed at publishing the case reported on page 112. The evidence brought forward by the Committee and its conclusions are not to be confuted; nor, however, is the fact of deaths like that described by Dr. Watkin Davies. It is probably correct not to regard the presence of the large thymus as the cause of death. In future another name will have to be given to a fatality of this kind. The facts remain: there is death without cause discernible post-mortem, and there is a thymus unduly large, even according to the limits assigned by the Committee for the organ at the age of the patient concerned. We must believe that there is in certain persons a defect which renders them abnormally prone to death. What that defect is we do not know, but it does not appear to be a thymic one.

ANÆSTHESIA IN THYROID SURGERY.

By C. Langton Hewer, M.B., B.S. (London).

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THE subject of anæsthesia in thyroid surgery was discussed at a meeting of the Anæsthetic Section of the Royal Society of Medicine on December 2nd, 1927, following a most able paper read by T. P. Dunhill. Since that date, two innovations in anæsthetics have appeared which have to some extent modified our former views; these are: The introduction of avertin and percain. And it may be interesting to consider how we can take advantage of these drugs to diminish still further the risks of thyroid surgery. In order to evaluate to some extent the magnitude of these risks, the writer has compiled figures for the operation mortality of the consecutive one thousand thyroid operations of every description anæsthetised by him prior to the introduction of the above-mentioned drugs:

1,000 Consecutive Thyroid Operations (partial thyroidectomy or ligature of thyroid arteries): 160 male, 840 females.

Immediate Mortality, i.e., deaths on operating table: Two cases, 0.2 per cent.

1. Middle-aged woman with toxic goitre. Preliminary injection of morphia gr. $\frac{1}{4}$; scopolamine gr. 1/100. Local infiltration with novocain 0.5 per cent, adrenalin 1 in 200,000. Sudden heart failure before operation started.

2. Young girl with toxic goitre (auricular fibrillation). Preliminary injection of morphine gr. $\frac{1}{4}$, scopolamine gr. 1/100. Local infiltration with novocain 0.5 per cent, adrenalin 1 in -200,000. Inhalation anæsthesia with nitrous-oxide oxygen. Sudden heart failure at end of operation while skin was being sutured.

Remote Mortality, i.e., deaths within 48 hours: Four cases, 0.4 per cent.

Three patients developed acute hyperthyroidism, two of which had severe tracheitis in addition. They were anæsthetized with the morphia-scopolamine, local, $N_2O.O_2$ technique.

The fourth case had morphia-scopolamine and local analgesia only. She died of broncho-pneumonia. An influenza epidemic was prevalent at the time, and it was thought possible that she contracted the infection. This was the only instance of pneumonia in the series.

Non-fatal Complications.

(1) *Reactionary hæmorrhage,* sufficiently severe to necessitate reopening the wound: Nine cases, 0.9 per cent. Six had local infiltration only and three had $N_2O.O_2$ in addition. It would seem that the comparatively dry wounds obtained with adrenalin without general anæsthesia do tend to give rise to subsequent oozing when the vaso-constrictive effect passes off.

(2) *Tracheitis*: 16 cases, 1.6 per cent.

Curiously enough, only two of these had endo-tracheal anæsthesia. The condition appeared to be due to the baring of the trachea during the operation and damage to the laryngeal nerves.

(3) *Conjunctivitis and Keratitis*: 21 cases, 2.1 per cent.

All occurred in patients suffering from pronounced exophthalmos. It is most important to see that the eyeball is kept lubricated with castor oil or liquid paraffin, and that no towels touch it during the operation. In extreme exophthalmias it may be necessary to keep the lids together with strapping.

In reviewing the fatalities of this series, we see that they total six cases (0.6 per cent). A figure which is lamentably high. The causes of death appear to be:—

(1) Heart failure before operation, apparently caused by injection of novocain and/or adrenalin in a toxic goitre patient.

(2) Heart failure at end of operation possibly caused by too great limitation of oxygen in a toxic goitre patient.

(3) Heart failure after operation caused by the toxic effect of excessive or abnormal thyroid secretion.

(4) Pneumonia after operation, possibly due to intercurrent infection.

The question which naturally arises is—Can these causes be eliminated or lessened? There seems to be some hope that they can.

Considering avertin first of all, we have a drug which ensures a quiet induction of anæsthesia in bed with the elimination of that apprehension which is such an important factor in thyroid surgery. If given in safe dosage it permits of a superimposed nitrous oxide-oxygen anæsthesia with a sufficiently high percentage of oxygen to avoid the least suspicion of cyanosis. This is not the case if morphine-scolopomine is substituted. Again, there is some evidence to show that the bromine in avertin acts in a similar way to the iodine in Lugol's solution by combining with the unsaturated thyroxin so that acute hyperthyroidism after operation should be less common. It is possible that one of the barbituric acid compounds such as "nembutal" given intravenously may supersede avertin, but this remains to be proved, although Ramsay and Little have reported favourable results with sodium amytal in 27 partial thyroidectomies: at any rate there is no doubt that the benefits awarded by some basal narcotic are now established.

Turning next to percaine, we have to consider what advantage, if any, it has over novocain, the drug which until recently has been used almost exclusively for infiltration. In this connection we are faced with the difficulty, which always arises after fatalities occurring under local analgesia, of deciding whether the novocain or the adrenalin is the toxic factor. It is unfortunate that no known local analgesia except cocaine is a good vaso-constrictor and that a strength of at least 1 in 200,000 adrenalin is necessary to produce adequate ischæmia whether novocain or percaine is employed. Crile considers that adrenalin is definitely contraindicated in toxic goitre cases and uses pure novocaine. On the other hand it is now definitely established that novocaine solutions without adrenalin can cause death, and three such fatalities have

occurred quite lately. Furthermore there are few surgeons who are willing to forego the bloodless wounds offered by adrenalin; so we must leave this factor untouched for the present, and simply compare percaine with novocain. The newer drug can, of course, be used in a high dilution, and it appears to be generally agreed that 0.05 per cent percaine is less toxic than 0.25 per cent novocain which is the weakest effective solution. The total amount of percain which is safe to inject into an adult at one time is estimated at 0.2 grms. which means 400 c.c. of a 1 in 2,000 solution, a quantity which should be more than adequate for the most ambitious anæsthetist. The analgesia afforded by percaine lasts considerably longer than that of novocain, so that post-operative pain is lessened. The few cases which the writer has infiltrated with 0.05 per cent percaine and 1 in 200,000 adrenalin have been quite satisfactory, but an inadequate number have been performed for a fair comparison with novocain to be made. Whichever solution is used, it is most important that none be injected intravenously, a point which will be elaborated later.

In the light of these recent developments in anæsthesia we might next consider the actual technique applicable to different types of thyroid operations.

The *Classification of goitres* from a pathological standpoint has involved much abstruse thought, but the anæsthetist may regard them in a totally unscientific and perfectly straightforward way. They may be simple, toxic, obstructive, or combined, i.e., both toxic and obstructive. The number of possible combinations of basal narcotics, local analgesics and general anæsthetics is, of course, enormous and the following is merely an attempt to describe briefly methods which the writer has found to be the most generally satisfactory in each type of case.

Simple goitres are those which give rise to no toxic or obstructive symptoms. In this connection one is reminded of the dictum of a famous surgeon who said: "Show me a gall bladder which is easy to remove, and I will show you one which does not need removing." Still, simple goitres are sometimes operated upon, mainly for cosmetic reasons. The

anæsthesia of such patients presents no special difficulty. A good technique is :—

Preliminary hypodermic injection of morphia gr. $\frac{1}{4}$ and scopolamine gr. 1/100 one hour before operation. Local infiltration of neck with 0.25 per cent novocain and 1 in 200,000 adrenalin followed by inhalation of nitrous oxide and oxygen.

Toxic goitres affect the anæsthetist mainly from their effect on the circulatory system. This may vary from a slight tachycardia to auricular fibrillation with decompensation. (93 patients out of the series of 1,000 were fibrillating). Certain patients with toxic goitre are also extremely nervous, and the slightest emotion greatly accelerates their pulse-rates. The basal metabolic rate of the group is always high. Patients suffering from the severe forms of this disease are very ill and require the most careful handling. Sometimes, indeed, it is unsafe to do more than ligature one thyroid artery at the first operation. After trying most anæsthetic techniques, the writer is of the opinion that the following gives the best all-round results. For some time before operation the patient is given an adequate daily dose of iodine and the date of the proposed surgical interference is never mentioned.

Two days before operation : Saline enema given.

One day before operation : Saline enema given at same time.

Three hours before operation : Lugol's solution m. xxv.

Two hours before operation : Morphine gr. $\frac{1}{8}$ hypodermically.

One hour before operation : Avertin 0.1 grm. per kilogram of patient's weight. This is slowly run into the rectum in a freshly prepared three per cent solution at body temperature. The injection should be at approximately the same time as that of the previous rectal salines. In nearly every case the patient will gradually become unconscious before realising that anything unusual is happening. The ears are then gently plugged with wool, the eyes are bandaged, and at the appointed time he is transferred to the operating table, where he is placed in the thyroid position and his forearms and thighs secured by towels against unexpected movements. The neck is

next infiltrated with either 0.25 per cent novocain or 0.05 per cent percaine and 1 in 200,000 adrenalin. A collar-shaped infiltration is performed starting from a mid-line wheal. The solution is then injected deeply through the analgesia area above and behind the upper pole of the thyroid gland so as to block the cervical nerves in the region of the transverse processes of the cervical vertebræ. In order to minimise the risk of the solution entering a vein, the needle point is kept on the move and the injection is made during the movements of withdrawal and not on those of entry.

The face-piece is next fixed in position with the rubber harness devised by Mr. Clausen and the operation is started. In a few cases no further intervention on the anæsthetist's part will be required. Usually, however, the enucleation of the thyroid gland gives rise to some tracheal traction and the patient may resent this and begin to move. If this is the case the flexible hose of the nitrous-oxide-oxygen apparatus is connected to the face-piece and inhalation anæsthesia started. It is unnecessary to interrupt the course of the operation and the patient is invariably still within two or three minutes. A high proportion of oxygen (usually 22 to 28 per cent) can be used, thus giving the main advantage of ethylene-oxygen without the drawbacks. The green towels now fashionable in certain surgical circles throw a blue shadow on the face and it is impossible to judge the patient's colour from observation of his lips or ears, and consequently the capillary ooze in the wound must be watched. This may sound a trivial matter, but the writer has often noticed that the faintest trace of cyanosis accelerates the pulse-rate of toxic goitre patients and is to be avoided. The frequency with which nitrous-oxide and oxygen is necessary can be judged by the fact that 72 out of the first 100 patients given this method required it. The anæsthetist should keep one finger upon the superficial temporal pulse and must be in a position to advise the surgeon whether the operation can or cannot be completed in safety in one stage. The after-effects of the anæsthetic are gratifyingly few, vomiting being rare. A nurse must, however, be in attendance for some time in case assistance is needed to clear the airway. Of the first 100 cases anæsthetized in this

way 84 were women and 16 men: 30 patients had continuous auricular fibrillation before operation. There has been one death, which occurred on the third day after operation from acute thyrotoxicosis.

Obstructive goitres present an entirely different problem and the main concern of the anæsthetist is to provide an efficient airway throughout the operation. It should be observed that if severe respiratory obstruction is present there will almost certainly be some venous obstruction as well, with consequent engorgement of the cervical veins. The commonest situations for tracheal obstruction are lateral compression in the neck from the two lobes of the thyroid gland and antero-posterior constriction in the thorax between the convexity of the spine behind and the tumour pushed back by the sternum in front. In addition, the whole trachea is sometimes displaced sideways from a unilateral goitre. A radiogram will often locate the site and nature of the obstruction.

The actual anæsthetic technique must be modified to suit each individual patient, but the following points seem worthy of attention. A small preliminary hypnotic incorporating a large dose of atropin is desirable, and the patient is placed upon the operating table in the position in which he breathes most comfortably. If he has a thoracic goitre this position will probably be with the head somewhat flexed. A local infiltration of the neck is next performed and most patients prefer to be rendered unconscious with nitrous-oxide and oxygen. Many operations can be safely accomplished with this simple method, but the anæsthetist must be prepared to pass a tracheal catheter at any moment should necessity arise. A soft rubber intubation tube will not, as a rule, be effective, as it will not pass the obstructions, but a semi-rigid catheter can usually be coaxed past, and on continuing the anæsthetic by insufflation, the gases will find their way out without the need for passing a second tube. A preliminary cocainization of the larynx may render this manœuvre less difficult. In extreme degrees of obstruction from thoracic goitre it may be necessary to have the head held right forward, and in these rare cases a smooth induction of anæsthesia may be made with

open chloroform. In the writer's opinion, this is the only occasion when chloroform is justifiable in thyroid surgery. When the sternum is split or the tumour is delivered by other means, the obstruction is usually relieved. During the course of the operation it is possible that one or rarely both pleural cavities may be opened. If this occurs, the anæsthetist must be prepared to maintain an adequate degree of positive pressure. If an endotracheal catheter has been used, caution must be observed when it is removed after operation. Certain types of large goitres lead to tracheal softening, and in one case complete obstruction occurred when the tube was removed owing to collapse of the trachea. The anæsthetist should, therefore, be prepared to reintroduce the catheter should this be necessary. A final word of caution may be added. In no circumstances whatever should an obstructive goitre be anæsthetized in bed or with any relative present. There are few situations more appalling than to see progressive respiratory obstruction occurring during the induction of anæsthesia in a bedroom with the anxious mother watching and with one's main apparatus in a distant theatre.

Combined toxic and obstructive goitres are not uncommon, and each case must be considered on its merits. One or other symptom is usually predominant and this should determine the anæsthetic technique to be adopted.

In conclusion it can be said that thyroid surgery offers a most interesting field to the progressive anæsthetist, and one in which his constant alertness is essential, since awkward situations can develop in a surprisingly short time.

*OBSERVATIONS ON THE PRE-OPERATIVE PREPARATION AND POST-OPERATIVE CONVALESCENCE OF THE SURGICAL PATIENT.

By J. Ross Mackenzie, M.D.

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1. Anæsthetic Service.

THE surgery of to-day is a deliberate, remedial and prophylactic art. No longer does the surgeon grasp the scalpel and look at the clock. Those of us who share the surgical task consider that the work is better done because it is not hurried, and believe that many patients are protected against future operations by a survey of the conditions within reach of the operation area. The pros and cons of "surgery to the clock," however, have a direct bearing upon anæsthesia, since the duration of the operation is an important factor in determining the anæsthetic and post-anæsthetic effects upon the patient. From this point of view, one may contrast the condition of the patient who has had twenty minutes' anæsthesia and the appendix removed through a McBurney incision with the patient who has had fifty minutes anæsthesia, the appendix removed and the abdomen explored through a para-central incision.

Surgery is tackling cases and material that but recently would have been considered inoperable. It is obvious that anæsthetics must deal with the same cases and material, and if the full benefits of modern surgery are to accrue to the patient, then the anæsthetist must compete with the surgeon,

*Delivered in opening a discussion at the Aberdeen Medico-Chirurgical Society.

in technique, in judgment, and in the management of each case. For example, the anæsthetist ought to investigate all cases of post-operative complications with a view to finding whether these complications were in any degree attributable to over-zeal, or omission in the preparation, to the anæsthetic agent chosen or the method of its administration, or to any error in judgment regarding the condition of the patient before or during anæsthesia.

It is essential that the modern anæsthetist be a man of judgment and a good physician, with such a knowledge of surgery as will enable him to anticipate the anæsthetic requirements of the surgeon. He is, in part, a physiologist, a pharmacologist, and a biochemist, and then from force of circumstances or a love of the art, but rarely from financial prospects, he becomes an anæsthetist. It is to be regretted that few of our first-class men remain long as anæthetists. The vocation appears to be mostly a temporary one, and a stepping stone to brighter prospects.

Recently a prominent anæsthetist gave it as one of the advantages of being an anæsthetist[1] that "when we leave our patients we leave our responsibility for them behind us." In my view, such an attitude on the part of the anæsthetist is destined to obstruct progress in anæsthetics, and I am convinced that if anæsthetics is to keep pace with surgery, and if the status of the anæsthetist is to be raised in the eyes of the surgical world, then the anæsthetist must be given, and must accept, a larger share of the responsibilty of the surgical patient before and after anæsthesia.

The correlation of the laboratory and clinical anæsthetics in our medical schools and affiliated hospitals leaves much to be desired. The fault does not appear to lie with the laboratory, for in my experience every encouragement and help have been given. The difficulty arises largely out of the arrangements for our anæsthetic service. Usually the anæsthetist does not meet the patient he is required to anæsthetise until he enters the anæsthetic room. From my point of view, such a service exhibits a lack of consideration of (*a*) the physical, mental, and pathological condition of the patient, (*b*) the surgeon and the particular surgical task on hand, (*c*) the type of anæsthetic best suited to the individual case, (*d*) the pre-

anæsthetic, anæsthetic, and post-anæsthetic effects upon the patient.

Without a doubt this type of service is an obstacle to progress in the science and art of anæsthesia. It can be remedied, and will be, if the best interests of the surgical patient are to be served.

Might not the anæsthetist be advised of the arrival of surgical patients in the hospital instead of being merely notified that a number of operations are to take place the following morning? Or, as an alternative, might not the anæsthetist be given thirty-six hours' notice of operations of election?

This procedure would place an onus on the anæsthetist and invite him to take such precautions with the patient before, during and after the anæsthetic as would enhance the prospects of a rapid and uninterrupted convalescence and of a reduction in surgical mortality. From the economic standpoint, also, it is evident that the result of such an effort would be a financial gain ultimately to the patient, to the hospital, and to the State.

2. The Evaluation of the Surgical Risk.

Apart from "snags" to the anæsthetist or the surgeon, there are very few patients so ill that they will not survive the operation table, in the hands of a competent anæsthetist. But, as a member of the surgical team, the function of the anæsthetist is to assess the immediate and remote risk involved in the anæsthetic and the operation from his own point of view. For this purpose he will visit and examine the patient at the earliest opportunity after admission to the hospital or nursing home, and if there is any purulent nasal discharge, septic tonsils, bronchial catarrh, or any other abnormal condition likely to prejudice the anæsthesia, or the convalescence and recovery of the patient, then he will advise that the operation be postponed until the particular handicap is effectually treated, unless the surgical indisposition be an urgent one.

There are clinical tests, to which the surgical patient may be subjected without undue disturbance, and which give valuable information regarding the measure of safe opera-

bility, the vitality of the patient, the powers of resistance[3, 4, 5, 6] to surgical trauma, and the condition of the blood and tissue chemistry. It is not suggested that any single test will in itself be sufficient evidence for or against surgical intervention, but collectively, and together with the general clinical examination, these tests are of great value in anticipating the effects upon the patient of prolonged, extensive, and difficult operations. They are especially useful where pathological conditions are present, quite apart from the surgical entity demanding intervention.

1. *Moots' index of operability.* This is found by dividing the diastolic blood pressure into the pulse pressure.

$$\frac{\text{Pulse Pressure}}{\text{Diastolic Pressure}} = \text{Index of operability in pressure radio per cent.}$$

$$= \frac{40}{80} = 50\% \text{ normal, or } \frac{75}{100} = 75\%, \text{ or } \frac{20}{80} = 25\%.$$

If the pulse-pressure ratio lies between 25 per cent and 75 per cent, the case is probably operable, whereas if it is outside these limits it is more probably an unwarranted surgical and anæsthetic risk.

2. *Froes* has provided a simple test that enables the anæsthetist to anticipate the early onset of surgical shock, and to institute prophylactic measures in the pre-operative period. He multiplies the systolic blood pressure by one hundred and divides the total by the percentage of hæmoglobin multiplied by the two figures indicating hundred thousands of red blood corpuscles.

$$\frac{\text{Syst. Pr.}}{\text{Hæmoglobin \%}} \quad \frac{150 \times 100}{75 \times 40} = \frac{5}{\text{R.B.C.}} \text{ or } \frac{170 \times 100}{67 \times 36} = 7+$$

The numeral seven is the extreme limit of safety and, apart from urgency, indicates protective measures and delay.

3. The *Energy Index*, or reserve vitality of the patient, is arrived at by adding the systolic and diastolic blood pressures together and multiplying them by the pulse rate. The numerals of the thousands are used as the index. S.P. 160 + D.P. 110 × P.R. 70 = 18,900 per minute of energy, or 200 + 120 × 90 = 28,800. The normal numerals are between twelve and twenty. Below twelve indicates cardiac weakness, and above twenty an excessive cardiac load.

4. *Sabrasez's Breath-Holding Test.* The reactions of the respiratory function give evidence of changes, in the acid-base balance of the blood and in the metabolic processes. The patient is invited to rest quietly for five minutes, then to take a full breath and hold it, with mouth and nostrils closed, as long as possible. The time is noted in seconds. This is a delicate and accurate clinical index of the blood and tissue chemistry, as well as of the vitality and endurance, of the patient.

These are measured by the number of seconds the breath can be held multiplied by 100 c.c.

The normal is 30 to 35 seconds, and the formula reads:

Male ... 35 seconds × 100 c.c. = 3,500 c.c. Vital capacity.
Female ... 30 seconds × 100 c.c. = 3,000 c.c. Vital capacity.

If the breath is held for 20 seconds only, there is evidence of acidemia, and if for 10 seconds, of acidosis.

5. *The McKesson Index* of danger to the patient on the operation table is the systolic blood pressure and the pulse rate.

(*a*) 1st degree. 10 per cent to 15 per cent increase in pulse rate without change in blood pressure, or 10 per cent decrease in blood pressure without change in pulse rate.

(*b*) 2nd degree. 25 per cent increase in pulse rate and 10 per cent to 25 per cent decrease in blood pressure.

(*c*) 3rd degree. Pulse of 100 or over and rising with a systolic blood pressure under 100 M.M.Hg. and falling. The third degree indicates a condition of grave danger to the patient.

3. Purgation, Enemata, and Starvation.

These are crude remnants of a time when the standard of asepsis and of surgical technique was different from what it is to-day, and yet they continue to be practised upon the surgical patient with unnecessary zeal. Have they the approval of the surgeon, or are they merely traditions left to the discretion of the nursing staff?

There is a principle in the preparation of the surgical patient that should be constantly kept in mind. The nearer the patient can be brought to or allowed to remain in the normal standard of physiological efficiency, the easier and less interrupted will the convalescence be.

There is one, temporary and doubtful, advantage to the surgeon of pre-operative purgation, enamata, and starvation, namely, an empty gastro-intestinal tract. There is also one advantage to the patient, since he may go for several days after an anal operation without being disturbed by any necessity for movement of the bowel.

Against these let me enumerate a few of the disadvantages. (*a*) Purgation and enemata cause[7] nervous and physical exhaustion with loss of sleep and rest. (*b*) They reduce the resistance to infective processes. (*c*) They hurry partially digested food along the intestinal tract, causing fermentation, tympanites, and abdominal pain. (*d*) The excessive action of the bowel tends to produce paresis of the musculature of the intestinal wall and paralytic ileus. (*e*) They result in an absence of the material which normally stimulates intestinal peristalsis. (*f*) They irritate the intestinal mucous membrane and leave it red and swollen, while the lumen of the bowel is collapsed or distended with gas. (*g*) Starvation deprives the surgical patient of the agent that maintains the normal gastro-intestinal absorptive and secretory functions. One of the conditions which definitely alters the absorption of carbohydrate, is starvation. The coefficient of absorption of carbohydrate after twenty-four hours' starvation was found experimentally to be 0.266 grammes per 100 grammes[8] body weight per hour, whereas after forty-eight hours' starvation, this figure was reduced to 0.178 grammes per 100 grammes of body weight per hour. (*h*) The ingestion and absorption of carbohydrate is essential to the normal metabolism of fat. (*i*) Incomplete oxidation of fats results in ketosis, which may continue for days after the operation, with vomiting and inability to retain and assimilate carbohydrate.

The natural habit of life in many individuals is to be constipated. In them[9] infrequent action of the bowel indicates a state of normal physiological efficiency, which is much deranged by purgation and enemata. The cæcum and ascending colon, normally, are rarely[10] empty, and any attempt to evacuate them by purgation or to keep them empty by a starvation diet is based on a misinterpretation of their essential function. In the judgment of the surgeon, is

it essential, or even important, to abdominal work to have the gastro-intestinal tract empty? Or is it within the resources of modern operative technique to deal with and safely open into the gastro-intestinal tract without its being first completely evacuated?

My own view as an anæsthetist is that drastic purgation, irritating enemata, and starvation are rarely necessary, never beneficial to the surgical patient, and in operations of election should not be practised within forty-eight hours of the time of operation.

4. Pre-Anæsthetic Medication.

Preliminary medication marks one of the greatest advances of anæsthetics in recent years. Apart from the anæsthetic agent itself there is no single factor in anæsthesia that has afforded the surgical patient more physical and mental benefit and protection than the introduction of the preliminary injection of morphine and atropine or the equivalent. The pre-anæsthetic use of alkaloids is a highly controversial subject. That they are[11] of value in some cases and appear to be a danger in others is merely a commentary upon the routine and the haphazard rather than the selective methods of their administration, and is not a proper reason for discarding them in all cases. In the interests of the patient, both enthusiasm and prejudice have need to be tempered with discretion, good judgment and experience.

The Advantages of Atropine Sulphate in Ether Anæsthesia.

(*a*) Atropine stimulates the rate and to some extent the depth of respiration and incidentally simulates the circulation. (*b*) It paralyses the terminals of the vagus in the bronchi, diminishes bronchial muscle tension, provides a freer airway and less tendency to anoxæmia. (*c*) In some degree it protects the patient against swelling of the respiratory mucous membrane, respiratory spasm and cough. (*d*) Atropine controls the terminals of the chorda tympani nerve and prevents the excessive secretion of saliva and mucus. (*e*) It hastens the induction of anæsthesia and diminshes the amount of anæsthetic required, since it reaches the alveoli and blood more readily. (*f*) Post-anæsthetic

respiratory disturbances and sickness occur less frequently with atropine. (*g*) It depresses the function of the sweat-glands. The evaporation of sweat causes loss of body heat and a tendency to surgical shock. (*h*) It prevents the excessive muscular movements and the expenditure of energy which occur when the extraordinary muscles of respiration endeavour to bring air and ether vapour into the alveoli through a column of mucous secretion.

A moderately dry anæsthesia is a decided advantage to the patient, the surgeon, and the anæsthetist.

Advantages of Atropine in Chloroform Anæsthesia.

(*a*) It has been shown experimentally in animals, and there is clinical evidence in support of the view, that atropine depresses or paralyses the terminals of the post-ganglionic fibres of the vagus nerve in the heart muscle. In this way atropine protects the heart against inhibition or fibrillation which is known to arise by afferent impulses from the operation area, sending stimuli through the vagus nerve to the heart. (*b*) In throat, bronchoscopic, and æsophageal work, atropine is particularly indicated, since it protects the patient against reflex irritation of the vagus and controls the secretion of mucus which otherwise may obscure the surgeon's view of the pathological area. (*c*) Chloroform may be replaced by ether at any stage of the operation without inconvenience to the patient, the surgeon, or the anæsthetist, if atropine has been given as a preliminary.

In my opinion, every surgical patient, unless there is some contra-indication, should have a preliminary dose of atropine, quite irrespective of the anæsthetic agent to be used. It is a great safeguard to the patient against cardiac collapse upon the operation table as well as against post-anæsthetic sickness and respiratory complications.

Morphine in Anæsthesia.

Morphine, as a preliminary to anæsthesia, requires to be used with much care and discrimination. (*a*) It should not be given if there is any history of idiosyncrasy. (*b*) It should not be given to infants nor young children. (*c*) It is contra-indicated in chloroform anæsthesia because, morphine and

chloroform both depress the respiration, and anoxæmia may result. (*d*) It is obvious, therefore, that morphine should not be administered as a preliminary to operation until the anæsthetic agent has been decided on. (*e*) Morphine is liable to produce or aggravate post-anæsthetic sickness. Apart from these conditions, and taking the necessary precautions to secure accurate and suitable dosage, in my experience, the untoward effects of preliminary morphine are outweighed by the mental equanimity with which the average patient arrives in the anæsthetic room and by the protection it affords against surgical trauma.

5. Selective Anæsthesia.

The anæsthetic agent or agents and their method of administration should be decided, on the merits of each surgical case, at the preliminary examination. The policy, which obtains in many institutions, of giving ether to all cases in one department,[12] chloroform in another, and gas and oxygen in yet another, is not calculated to serve the interests of the patient. It is a principle which results from deficient equipment, from a preference on the part of the surgeon or the anæsthetist, from some member of the surgical team taking the line of least resistance, or from consideration of economy in time and cost. There are no scientific or clinical grounds on which such a policy can be defended.

To be expert in any one method of anæsthesia is an accomplishment to be highly commended, but the practice of the indiscriminate use of the same anæsthetic agent in a series of consecutive cases, without regard to the condition of the patient or the surgical task, is a menace to any progress in anæsthesia. It may be true that, in the majority of these cases, the anæsthesia is satisfactory and the patient recovers, but my contention is that the anæsthetic risk to the patient has not been calculated from the scientific point of view, and may be greater than is necessary. There are certain principles which govern the choice of the anæsthetic agent:

1. The immediate and remote safety and comfort of the patient. Every anæsthetist knows that there are cases where chloroform is safer than ether, or colonic ether safer than inhalation ether, and that a spinal analgesia may be safer and easier than any form of general anæsthesia.

2. The site and duration of the operation. For a spinal or cerebellar tumour an endotracheal gas-oxygen-ether anæsthesia is by far the safest, easiest, and most efficient type of anæsthesia. It is apparent that in the average patient an anæsthesia of twenty minutes' duration will require less consideration as to the choice of agent than one of fifty minutes' duration.

The toxic anæsthetic and post-anæsthetic effects upon the patient become enormously increased after the first thirty minutes of anæsthesia.

3. The psychic and physical condition of the patient. The terror-stricken or the toxic patient is the worst possible subject for chloroform anæsthesia.

4, Adequate anæsthesia and a clear operation area are essential to the surgeon. In excision of the tongue or in the repair of a cleft palate it is evident that inhalation anæsthesia will make the operation vastly more difficult to the surgeon, and more dangerous to the patient than if colonic ether or endotracheal anæsthesia is the method of choice. Infinite care and judgment in the selection of the anæsthetic agent and the method of its administration will amply repay the whole surgical team by safety to the patient, efficient anæsthesia, and a clear operation field.

6. Hyperventilation as a Prophylactic Against Post-Anæsthetic Respiratory Complications.

Carbon dioxide, far from being a waste product of metabolism, has been shown to have functions in the animal economy of vital importance to the individual[13, 14, 15] and its use as an adjunct to surgical anæsthesia can be justified on scientific and clinical grounds.

There are surgeons, clinicians, and anæsthetists who remain suspicious of the propriety of giving CO_2 in anæsthesia, because of the danger of producing asphyxia. The change in the blood gases in asphyxia is primarily a deficiency of oxygen with retention of carbon dioxide, and is essentially the result of hypoventilation.

Rebreathing has been long recognised as an important factor in anæsthesia because it conserves the carbon dioxide in the expired air.

The normal metabolism is depressed in the pre-anæsthetic period by psychic phenomena, starvation and purgation, and in the anæsthetic period by morphine, the anæsthetic agent and surgical trauma. As a result the percentage of carbon dioxide, one of the products of metabolism and the chief stimulant of the respiratory function, is reduced.

It has been shown that oxyhæmoglobin tends to retain its oxygen if there is any lack of carbon dioxide, and the tissues may actually suffer from anoxæmia, though clinically the colour is normal.

I have long held the view that the shallow respiration and the limited excursion of the diaphragm that occur more especially in upper abdominal operations[16] and during post-operative and post-anæsthetic sleep, definitely predispose the patient to post-operative respiratory complications by defective inflation or actual collapse of the pulmonary alveoli at the bases of the lungs.

More recently, as the result of experimental and clinical work, the collapse[17, 18] of the pulmonary alveoli has been shown to be secondary to partial or complete occlusion of the bronchi or bronchioles, with stagnant and viscid secretion.

The sequence of events would appear to be as follows :—

1. As the result of some reflex stimulus the mucous membrane of the bronchi and bronchioles is irritated, becomes swollen and secretes mucus. If this secretion becomes infected with bacteria from the throat or respiratory tubes bronchitis or bronchiolitis will result.

2. If the exudate into the tubes occludes the lumen, then the pulmonary alveoli beyond collapse by absorption of their gaseous contents, and we have atelectasis or massive collapse of the lung.

3. If the exudate which occludes the bronchus becomes infected with the pneumococcus type 4, then we get cellulitis of the lung tissue and lobar or lobular pneumonia.

4. If the exudate becomes infected by pyogenic organisms, abscess or gangrene of the affected lung tissue may result.

According to this theory, a plug of exudate partially or completely occludes the lumen of a bronchus or bronchiole, becomes infected with organisms of more or less virulent type, producing bronchitis, capillary bronchitis, pneumonia of lobar or lobular character, atelectasis or massive collapse and abscess or gangrene of the lung, and may occur in spinal, local, or general anæsthesia.

It has been observed that, in the cases which have developed post-anæsthetic respiratory complications, there is frequently present, before operation, a catarrh of the naso-pharynx and upper part of the respiratory tract, and I have found from swabs of the nose and throat before operation and from examination of the sputum after, that the predominant organism is invariably the one found before operation.

There is one advantage of carbon dioxide to which due consideration has not so far been given by anæsthetists, and that is that a full tidal respiratory wave during anæsthesia, and hyperventilation of the respiratory tract towards the close of the surgical procedure and after, is a prophylactic against post-anæsthetic respiratory complications.

In 1925, I commenced the use of carbon dioxide in anæsthesia. Previous tc that date I practised continuous rebreathing and auto-de-etherisation by conserving the carbon dioxide of the expired air in the gas bag. My experience of carbon dioxide has gradually impressed me with its advantages in hastening the induction of anæsthesia, maintaining the cardio-vascular and muscle tone during a long operation, in restoring the blood pressure during or after a severe surgical test, and in rapid de-etherisation of the patient.

A review of 2,000 cases of surgical anæsthesia in which CO_2, 2 per cent to 6 per cent, was given has convinced me of its utility and value as an aid to the general convalescence and recovery of the patient, and especially as a preventative or minimizing agent against serious post-anæsthetic respiratory complications.

It is not claimed that CO_2 will prevent cough or sputum or temperature after an operation if bronchial catarrh and the bacillus of influenza or pneumococcus are already present, but

in normal cases it will prevent, and in infected cases it will minimise, the respiratory complications.

The hyperventilation of the surgical patient has a disadvantage to the surgeon in that the excursion of the diaphragm is increased and may disturb his work.

In ideal circumstances, hyperventilation and de-etherisation with carbon dioxide should be carried out after the surgical procedure is finished.

On the other hand, the shorter the anæsthesia and the sooner hyperventilation can be conveniently carried out, the more rapidly and effectively will return the activity of the respiratory cilia, the peristaltic action of the bronchial muscles and the cough reflex, to remove any foreign material from the respiratory tract.

In conclusion, carbon dioxide stimulates the depth of respiration and forcibly opens up the bronchi, bronchioles, and pulmonary alveoli. Ventilation and drainage of the respiratory tract is adequately accomplished in this way, and the accumulation and infection of mucous secretion is prevented.

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A RECORD OF ONE HUNDRED CASES OF HIGH SPINAL ANÆSTHESIA.

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IN the course of an extensive study of the literature on spinal anæsthesia the paper by Falkner Hill, of Manchester, published in the *Lancet*, January, 1930, was considered to contain the most practical advance in high spinal anæsthesia. It is the anæsthetic solution suggested by Falkner Hill which has been used throughout these hundred cases. The solution is of planocaine and gliadin in 15 per cent ethyl alcohol, the gliadin delaying the absorption of the planocaine and decreasing the difusibility of the solution in the cerebro-spinal fluid. The preparation used is put up in ampoules by Messrs. May and Baker, containing 0.1 grms. planocaine and 0.00325 grms. gliadin per c.c., 15 per cent ethyl alcohol. This solution has a density of 1.002 as compared with cerebro-spinal fluid, the density of which is 1.06. These hundred cases have in no way been selected, but as many different types of surgical procedure as possible were chosen, varying from extensive gastrectomy to excision of the hip joint, and acute inflammatory conditions have not been excluded from the series. The youngest patient was six years old and the oldest seventy-two.

In the past the main objections to spinal anæsthesia have been the inability to control the height of anæsthesia, the marked fall of blood pressure, the short duration of anæsthesia, and the toxicity of the solutions used. The technique described below overcomes each one of these objections. The height of anæsthesia may be regulated by the bulk of the total injection into the theca. By total injection is meant an amount of anæsthetic solution diluted with cerebro-spinal fluid in the syringe. Thus a total injection of 5 c.c. into the normal-sized adult will produce anæsthesia up to the

fourth rib, whereas a total injection of 3 c.c. into the same patient would produce anæsthesia up to the ensiform cartilage. The fall of blood pressure was practically negligible in 83 per cent of these cases, was noticeable but not marked in 15 per cent, and was marked in 2 per cent. In all cases the fall was overcome by some degree of Trendelenburg position of the table. It must be remembered that the fall of blood pressure produced by paralysis of the vaso-constrictors within the anæsthetised area is not of the same nature as a progressively steady fall of blood pressure following a lengthy surgical operation accompanied by shock and hæmorrhage. It indicates only that the head must be lowered, thus abolishing any fear of medullary anæmia, and that this position be maintained during anæsthesia. In the two cases in which the fall of blood pressure was very marked nothing was done except to increase the Trendelenburg position. In both cases, one a child of six years who was given 2 c.c. of anæsthetic solution, making it up to 3 c.c. with cerebro-spinal fluid, and the other an elderly fat woman of sixty-two with some myocardial degeneration, the respiration became snatching (no inhalation anæsthetic was being given) and no pulse could be felt at the wrist or in the pre-auricular division of the superficial temporal artery; the pulsation of the common carotid could just be felt; the eyes rolled upwards; there was extreme pallor of the face and lips, and, in fact, the picture was one of imminent death. In the case of the child, anæsthesia had been obtained up to the second rib six minutes after the intra-thecal injection, and a light open ether anæsthesia was about to be commenced. Upon tilting the table still more head-downwards, the patient's condition was rapidly restored to normal, and it was found that the level of anæsthesia was unaltered. In the case of the adult, the operation had begun, twenty minutes having elapsed since the intra-thecal injection. Anæsthesia in this case was up to the nipple line. Within four minutes of increasing the Trendelenburg position, the patient's condition was normal and the surgeon had recommenced his operation. Both these cases had an extensive operation, and both were exceedingly well next day, and made uninterrupted recoveries. The 15 per cent of cases where a blood-

pressure fall was noticed but was not marked were simply treated, as with all the cases, by a four degrees Trendelenburg tilt. The duration of anæsthesia was found in this series of cases to depend on the amount of the anæsthetic solution used. With 3.5 c.c. of the solution upper abdominal anæsthesia and good relaxation lasts for from 2–2¾ hours. There have been cases in this series where the surgeon has been 2½ hours before closing the upper abdominal peritoneum. The longest time was 3 hours 10 minutes without general anæsthesia, during which time a carcinoma of the rectum, involving many structures, was removed. It was known that the case was to be difficult, and 4 c.c. of the anæsthetic solution was injected intra-thecally. The patient's condition was extremely good at the end of the operation, and he made a rapid convalescence. In regard to toxicity of the solution, it can only be said that no toxic symptoms whatever were detected in any of the cases. The complications described later are only what might be expected to result from paralysis of two-thirds of the body followed by surgical procedure.

Technique.

The apparatus required is simple. A 2 c.c. syringe and hypodermic needle, a 5 c.c. syringe and spinal needle, ampoules of duracaine and the local anæsthetic and ephedrine solution. It is more convenient to use a mixture of ephedrine hydrochloride, 0.05 grms. per c.c., and planocaine, 0.01 grms. per c.c., in normal saline, put up by Messrs. May and Baker in 1 c.c. ampoules, so that the local anæsthetic for the skin and the vaso-constrictor are introduced together, thus reducing the number of injections. It is convenient to keep the ampoules in jars of spirit, as when they are required for use they are sterile and may be handled by the anæsthetist instead of bothering about assistance. The question of a spinal needle is also to be considered. The large needles are more liable to tear the dura and thus allow some of the anæsthetic solution to leak out, and also to cause pain during their insertion. A needle, size No. 20 B.W.G., about four inches long with a stillette, is most satisfactory. The point of the needle should not have a long tapering bevel, but

should be short, making an angle of forty degrees with the long axis of the needle. This practically insures the whole of the bevel of the needle being intra-thecal, whereas with a long tapering bevel only half may be intra-thecal; thus it is possible to withdraw cerebro-spinal fluid, but part of any injection is lost extra-thecally. It is well, also, that the needle be made of fine spring steel, so that should the patient suddenly extend the back the needle will bend and not snap off. The two syringes, the needles and a small file, with which to open the ampoules, should be sterilised by boiling in distilled water—thus ensuring the absence of alkalies which may destroy the planocaine.

The injection is made in the usual way, but the patient should be lying upon an operating table if anæsthesia is required above the umbilicus; any fall of blood pressure can thus be immediately remedied or the height of anæsthesia dealt with by tilting the table. The anæsthetic solution, as already pointed out, is lighter than cerebro-spinal fluid, and since the gliadin delays diffusion the bulk of the injection will tend to rise to the highest point in the thecal space. Directly the injection has been made, the whole table should be tilted "head up and feet down," or anti-Trendelenburg position, thus giving the injected fluid a definite tendency to rise. The actual degree of tilt matters not. Originally it was thought that the height of anæsthesia depended almost entirely upon the anti-Trendelenburg tilt of the table, and that variations of two or three degrees made all the difference. In these cases, however, it has become quite clear that so long as there is enough tilt on the table to make the upper thoracic region the highest point in the "vertebral line," thus tending to cause the anæsthetic to rise, the actual degree of tilt is of little importance. For normal average-sized adults this tilt is about ten degrees anti-Trendelenburg.

The skin and the tissues down to the dura are anæsthetised with 1.5 c.c. of the planocaine-ephedrine solution. The ephedrine, acting peripherally, causes a transient vaso-constriction, so that the central paralysis of the vaso-constrictors, which follows the injection of the duracaine, cannot bring about a fall of blood pressure until the ephedrine has lost

its effect, by which time the patient is in the Trendelenburg position. The required quantity of duracaine is then drawn up into the 5 c.c. syringe, the spinal needle is inserted into the subdural space, the 5 c.c. syringe attached to this needle and as much cerebro-spinal fluid as necessary slowly withdrawn into the duracaine; a few moments are given for the two fluids to mix, and then the whole is injected—five to ten seconds being taken to make the actual injection. The needle is then withdrawn and the patient placed upon his back. It is well to flex the hips and the knees, so that the soles of the feet rest upon the table, as in this position the lumbar curve is reduced to a minimum. The table is then tilted to about ten degrees, head up or anti-Trendelenburg. Anæsthesia comes on in from six to fifteen minutes, starting in the feet and working gradually upwards. When the required height of an anæsthesia is reached, the table may then be tilted in the opposite direction to allow for any fall of blood pressure —a four degrees tilt in most cases is sufficient. Loss of consciousness is usually desired by the patient or the surgeon, and in most cases by both. In this series, this has been produced by ether, or gas and oxygen, or a large dose of morphia, or even intravenous sodium amytal. The quantities of injection for the various heights of anæsthesia have already been mentioned. The amount of anæsthetic solution in those quantities depends upon the time required for the operation : 3.5 c.c. of the anæsthetic will give upper abdominal anæsthesia for two hours. It is wiser to allow the surgeon too much time rather than risk being stranded with an incomplete operation and no anæsthesia.

Complications.

Immediate. One of the most trying complications of this procedure is a stupid patient, both when making the injection and when testing for the height of anæsthesia. It must be remembered that at the upper limits of anæsthesia pressure can be felt by transmission, whereas the sense of pain is lost. Also intra-abdominal manipulation may give rise to intra-thoracic sensations. These two facts often cause a nervous or stupid patient to be extermely trying. These cases can only be dealt with by tact and experience : to use an Ameri-

can expression, psycho-anæsthetics. Vomiting, or extreme nausea, has occurred in 21 per cent of cases. It is probably due to the paresis of the stomach and the position of the table allowing any gastric mucus to drain into the œsophagus. It is usually transient, being relieved by the patient spitting up a small quantity of gastric contents, but may recur. The reflex set up is not a powerful one, for very light general anæsthesia controls it. Delayed onset of anæsthesia has occurred in 7 per cent of the cases; the longest interval between the injection and the onset was forty-seven minutes. In these cases it is usual to find that the lower limbs and lower third of the abdomen become anæsthetised in about six minutes, and that the remainder of the abdomen and lower thorax suddenly become anæsthetised after a varying interval of time. It has been the writer's practice always to tilt the table to some degree of Trendelenburg position fifteen minutes after the injection has been made. The reason for this delay cannot yet be stated, but it is probably due to some anatomical condition delaying absorption of the anæsthetic.

Delayed. Prolonged operations without general anæsthesia in nervous or temperamental patients may result in a state of restlessness often extremely difficult to control. The only movements possible are, of course, of the hands and tongue—both may make the surgeon's work extremely trying. It is wise, therefore, if no general anæsthetic is to be given, to fasten the wrists loosely but firmly to the sides of the table. Loss of anæsthesia has occurred in 2 per cent of the cases. In one case motor power and sensation had returned half an hour after their disappearance, and in the other case three-quarters of an hour after. Both were cases in which great difficulty had been experienced in introducing the needle into the theca, and it is probable that the dura had been torn, thus allowing some of the anæsthetic solution to leak out. Sudden death has occurred in 2 per cent of the cases. The first case was a woman aged sixty-two, slightly jaundiced, with calculi in her gall bladder, and a great deal of "sludge" in the common bile duct. She was a fat subject with distant heart sounds and arterio-sclerosis. Death from acute heart failure occurred fifty minutes after the operation

had begun. There was absolutely no indication that anæsthesia was passing off. Post-mortem examination showed advanced fatty degeneration of the myocardium, and atheroma of the coronary arteries. The second case was a man—a good operative risk—upon whom a perineo-abdominal excision of rectum was being performed. A descending colotomy had been performed ten days previously. The operation was almost completed and the patient's condition was remarkably good, when he suddenly died—1 hour 20 minutes after injection of the anæsthetic. Post-mortem revealed a large pulmonary embolus which had quite definitely arisen from the left internal illiac vein, and probably formed after the operation for colostomy.

Post-operative. There is no doubt whatever that the amount of shock apparent in these cases is markedly reduced. If a general anæsthetic has been given, the vomiting is not more than may be expected, but 4 per cent of the cases had marked vomiting and no general anæsthetic. Two of these cases were given tea on their return to the ward following operations for hernia. The tea was ordered by the writer, who has since realised that it is unwise to fill the paralysed stomach! One of the other cases—also a hernia—had severe vomiting for two days, and at one time was suspected of being a case of paralytic-ileus. No case of severe headache or backache, so often associated with spinal anæsthesia, have been seen in this series. Pulmonary complications have been met with in 3 per cent of cases. One of these cases is of particular interest. A big, fat, chronic bronchitic, with bilateral inguinal hernia. The hernia on the right side had been operated on one month before under a general anæsthetic, and he made an uninterrupted recovery. The hernia on the left side was done under high spinal, anæsthesia being obtained up to the nipple line. By the second day after operation, he had developed an extensive broncho-pneumonia, from which he very nearly died. Retention of urine has occurred only once—this was a case of chronic appendicitis in a young woman, and she required catheterising only once. No changes in the central nervous system have been seen after the anæsthesia has passed off, nor any alteration in the healing of the wounds.

Indications.

The indications for high spinal anæsthesia are undoubtedly very debatable, and largely a matter of opinion and experience. The chronic bronchitic is surely subjected to grave risk by paralysing the intercostal muscles for two hours, thus causing diminished air entry to the lungs. The formation of areas of collapsed lung must follow, and thus the dreaded broncho-pneumonia is encouraged. Whereas an anterior abdominal wall block followed by an anterior splanchnic block when the abdomen is open is less likely to enhance the pulmonary disease. On the other hand, a case of recently healed pulmonary tuberculosis with no moist sounds in the chest, would be one most deserving of a high spinal rather than an inhalation anæsthetic. Those patients whose cardio-vascular system do not warrant a deep general anæsthetic, the diabetic and those with renal disease, are also surely cases where high spinal anæsthesia is indicated. Another great class of case which calls for spinal anæsthesia is that class in which prolonged surgical manipulations are to be undertaken, or where the surgical procedure is going to give rise to much shock—for undoubtedly this anæsthetic solution protects the patient from shock to a very marked degree. The muscular relaxation obtained is also remarkable, and so those cases of large abdominal tumours, where the surgeon is going to require all the relaxation possible, are most suitable for this anæsthetic. There are also those few cases—highly toxic patients, whose acute surgical conditions have become chronic, and where general anæsthesia or large doses of novocaine would probably be fatal—in which this method of anæsthesia can be, and has been more than once in this series of cases, a life-saving anæsthetic.

In closing, the writer would express his great appreciation to the anæsthetists and surgeons at the Middlesex Hospital for all their kindness, advice, encouragement, and patience throughout the collection of these cases.

DEATH DURING NITROUS OXIDE ANÆSTHESIA FOR PROPOSED EXTRACTION OF TEETH—STATUS THYMICO LYMPHATICUS.

By C. Watkin Davies, M.B., B.S. (Birmingham).

THE case of a death under nitrous oxide before any dental extraction had been performed in a youth of nineteen, the autopsy of whom showed well-marked status lymphaticus, seems worthy of record, especially in view of the enormously wide use of this comparatively safe anæsthetic among medical men, dentists, and students.

On Saturday morning, August 9th, 1930, the patient presented himself at the Birmingham Dental Hospital about 9-0 a.m., and according to the usual routine his mouth was examined and he was sent home to obtain signed permission for the administration of an anæsthetic for the purpose of extracting two teeth and roots. It subsequently transpired that he had cycled both ways (one and a half miles each way) with a small boy on his carrier for the return journey. He then, at 10-55 a.m., came into the anæsthetic room: he was a small, poorly-developed youth, looking more like 16 than 19 years old, with rather a vacant expression and seeming more nervous than the average patient. There was nothing apparent, however, to contra-indicate the giving of nitrous oxide for the extraction of the teeth. A gag was inserted by the dental house surgeon and I started him with a nasal inhalation in the usual sitting position. He became excited and refused to breathe through his nose, so I changed to a full face-piece. His respirations became deeper, his colour cyanosed, and in about 20 seconds I removed the face-piece intending to change to the nasal inhaler again and at the same time gave the signal for the extractions. The house surgeon depressed the tongue prior to inserting the sponge, but before this was done the patient became slightly more cyanosed—though it is significant that he never became as

deeply cyanosed as in normal nitrous-oxide anæsthesia—and then his respirations ceased suddenly and completely. The usual remedies were immediately applied, he was placed on the floor, the tongue pulled forward, artificial respiration performed, oxygen, injections of strychnine and pituitrin given, but he never responded.

On subsequent questioning, his mother stated he had never been a robust youth but had never had any serious illness.

I am greatly indebted to Dr. Oscar Brenner, Demonstrator in Pathology, University of Birmingham, for allowing me to publish the following notes which he made on performing the autopsy, and his conclusions :—

The body was that of a small poorly developed youth looking younger than his age. There was no cyanosis of the face, which was pale. There were a few small recent abrasions on each side of the front of the chest, near the nipples, but no other external evidence of injury. These were probably caused by artificial respiration.

Pluræ. Left showed old adhesions. Right appeared normal.

Lungs were somewhat congested and very œdematous. There was no foreign body in any part of the respiratory tract.

Pericardium showed no abnormality.

Heart appeared normal. The valves were all competent and the coronary arteries were healthy. The aorta was rather strikingly narrower than normal.

Peritoneal cavity showed no abnormality.

Alimentary tract appeared normal, apart from the fact that the lymph follicles in the small intestines were a little more prominent than usual.

Liver showed no abnormality.

Spleen was a little enlarged and the Malpighian bodies were greatly enlarged so as to be almost confluent.

Kidneys appeared normal.

Brain showed no abnormality.

Lymphatic apparatus. The thymus was persistent and much enlarged, reaching up into the roots of the neck and down over the front of the pericardium. Its weight was

50 gms. The pharyngeal and lingual tonsils were much enlarged. The mesenteric lymph glands were enlarged and prominent, and appeared very numerous. As already mentioned there was great hyperplasia of the lymphoid tissue of the spleen, perhaps a little in the intestine.

Suprarenal glands appeared normal.

The cause of death, in my opinion, was status thymico-lymphaticus with sudden heart failure under nitrous oxide anæsthesia.

SECTION OF ANÆSTHETICS.

(Royal Society of Medicine).

THE session of February 6th, under the Presidency of Dr. Featherstone, was given up to a discussion on high spinal analgesia.

Mr. A. Dickson Wright read a paper which considered fully and judically all aspects of endothecal injection for anæsthetic purposes, the process which he thinks should most properly be spoken of as "selective intrathecal nerve block." This name would prevent any misconception as to action on the cord itself, an idea encouraged by the term "spinal analgesia." Mr. Wright showed how the cocaine group of anæsthetics are selective for sensory nerve fibres and how this selective quality is heightened by the anatomical disposition and shape of the posterior roots as compared with the anterior. Total anæsthesia without paralysis has been produced by intrathecal injection. Referring to dangers arising after spinal injection the speaker mentioned intravenous adrenalin as a wonderful restorative. He thought it a more certain antidote than any available for troubles with general anæsthesia. The fall in blood pressure he disregarded as a danger. Mr. Dickson Wright valued spinal analgesia highly for thoracoplasty and for dissections of the neck. For upper abdominal operations it gave the surgeon great ease. The only contra-indications admitted by Mr. Wright were (1) increased subarachnoid pressure; (2) septic conditions of the spinal column itself; (3) perforations of the small and large intestine.

Mr. Howard Jones contested some of the theories advanced in the paper. He did not believe that 2 or 3 c.c. of novocaine injected with force against the leash of nerve trunks of the cauda equina could travel any distance up the canal, nor did he think the anatomical arrangements of the ligaments affected the disposition of injected fluid. The spine may be injected to any amount if the solution is dilute enough to have a selective action on sensory fibres only, but the resulting analgesia may not suffice for a long operation.

Mr. Charles Donald laid stress on the head-down position as the greatest factor of safety with spinal analgesia.

Mr. Langton Hewer found percaine superior to all other drugs for spinal injection for operations below the diaphragm.

The March meeting was held, by consent of the Vice-Chancellor, at the University of Bristol on March 7th, Dr. H. W. Featherstone,

the President, in the chair. A symposium on the barbiturates in anæsthesia was opened by Dr. M. Nierenstein, who described in detail the chemistry of barbituric acid and its derivatives. He showed that all those drugs which have recently attracted so much attention, from veronal through allonal and medinal to sodium amytal and nembutal, are attributable to the chemical work of Nebenthau in 1898–1901. The Nebenthau factor, NH–CO, the exclusion of mobile hydrogen and the various side chains, were explained by the speaker, who showed how the presence or absence of narcotic properties in any given organic compound of this series could be foretold. Chemically he had little to say in favour of pernocton, but showed how the asymmetrical carbon atoms of amytal and nembutal favoured their absorbability by the human body. Veronal, luminal, allonal, and neonal he regarded as chemically identical. Dr. Nierenstein regretted the fact that hitherto all the chemical advances from barbituric acid had been made along the line of least resistance, and thought that perhaps more valuable compounds could be obtained if chemists sought those that were less easily constructed.

Mr. A. L. Taylor, regarding the barbituric compounds as hypnotics, analgesics, or anæsthetics, had sought to arrange their qualities in accordance with molecular weights, stability, relationship between minimum active and lethal doses, and excretory facility. He found that a quick breakdown in the organism, and consequent irrecoverability from the urine, was essential if these bodies were to act as anæsthetics. A small dose and rapid decomposition were desirable and these were represented in nembutal.

Mr. A. L. Flemming spoke from clinical experience, and pointed out the necessity for prolonged care and watchfulness over patients in the recovery stage of anæsthesia after the use of barbiturates.

Mr. W. S. V. Stock had been using pernocton systematically for three months and was well pleased with it. He gave it at the rate of 1 c.cm. per minute and preceded it by an injection of morphia given 20 minutes earlier.

Dr. Featherstone had employed sodium amytal and nembutal. either by the mouth or intravenously, both for normal labour cases and for Cæsarean section with spinal analgesia. For the latter purpose he gave grs. 4½ by the mouth one hour before operation. No other medication was employed, and he varied the dose to grs. 3 for feeble, pale, or undersized patients. The patient was kept quiet in a darkened room till the time came for the spinal injection. Then she was turned gently on to the side. She was usually asleep or tranquil if awake. The injection was then made through an intradermal wheal raised by novocain. The eyes were then covered and the patient arranged on the operating-table. At this stage there was often discomfort and sometimes retching before one used membutal. In most instances after the use of nembutal recollection of the opera-

tion was hazy, if there was not complete amnesia. There was great difficulty in gauging the dose to give by the mouth. Sometimes the full effects were present a quarter of an hour after the capsules had been swallowed, in other instances more than twice as long was necessary. No second dose was given. The uterine contraction was good in every instance and the child unaffected except for slight sleepiness. There was never any depression of breathing in the infant. Out of 11 patients one had severe headache for two days. Restlessness or pain after the operation was controlled by gr. ⅙ or gr. ¼ morphia. In the presence of serious renal affection one should be wary of employing nembutal. Intravenous sodium amytal and nembutal had not proved satisfactory in combination with spinal analgesia, the fall in blood pressure being too great. With regard to midwifery he had found that 1 g. of sodium amytal injected intravenously just before full dilatation of the os produced painless labour. The frequency of uterine contraction was unaffected and the child in no way embarrassed. The dose must be given slowly. Sodium amytal was preferable to nembutal, the effect lasting longer. A normal woman after 1 gr. would go through 6 to 10 hours' labour with little more than a dim memory of the pain occurring at the time of the actual birth of the child. After quick deliveries patients often remembered nothing from the time of the injection till hours after the delivery. The regular contractions of labour continued with the same rhythm during and after the injection of the drug. There was some danger of precipitate passage of the head over the perineum with resulting tear. At the time of delivery there was sometimes excessive restlessness, making the patient hard to control. A series of small doses of amytal proved less satisfactory than the one big dose.

Mr. F. S. Tait corroborated Dr. Featherstone's experiences with sodium amytal and related the details of a primipara whose labour was conducted under the influence of a dose of 0.5 g. given in five minutes. Pains were then occurring every five minutes. The birth had taken place 2½ hours later. The baby cried directly after birth and the mother when fully conscious two hours later had no knowledge of the confinement at all. Mr. Tait laid stress on the difficulties sometimes arising from restlessness and on the danger of precipitate expulsion when the head reached the perineum.

Dr. H. H. Rubra pointed out the advantage of sodium amytal in operations for submucous resection of the nasal septum. A bloodless field was easily obtained. He gave morphia one hour before and grs. 6 to 9 af amytal. He thought that no barbiturate should be employed in the presence of any active lung lesion.

Mr. Langton Hewer had employed nembutal by the mouth and referred to the difficulty of estimating the correct dose and to the idiosyncrasy towards the drug which might be encountered. In one instance a man of 30 who received grs. 4½ of nembutal and then

nitrous oxide and oxygen was semi-delirious on recovery and then vomited for six hours. On a second occasion he underwent a similar operation under nitrous oxide and oxygen preceded by "Hyocine A" and was not sick at all.

Sir Francis Shipway regarded all intravenous methods as associated with a certain amount of inevitable risk. He had seen good results from nembutal by the mouth associated with small doses of morphia. This combination, however, was never to be employed upon children.

Mr. R. J. Clausen spoke strongly in favour of pernocton. He found that to combine it with morphia was an uncertain proceeding, some patients requiring more of the pernocton and taking longer to become anæsthetic than when no morphia was used.

After the discussion Prof. R. J. Brocklehurst demonstrated two cats who had been given, one sodium amytal and the other nembutal by intraperitoneal injection. The dosage had been several times as great as that used with human beings. The narcotic effect was obviously extreme and both animals appeared more dead than alive.

ABSTRACTS.

"Twilight-sleep" versus pain alleviation in childbirth. PROFESSOR H. SELLHEIM. *Schmerz Narkose-Anæsthesia,* Jan., 1931.

The author says a clear distinction should be drawn between the two things. He confines the term "twilight-sleep" to a long process brought about by one or more injections by means of which the mother's mind becomes bemused over most or all of the confinement and the recollection of it destroyed. In contradistinction to this is his constant practice of administering by the mouth, to every mother who wishes it, something which will diminish or abolish the pain at the most critical time of a labour. The author employs a mixture consisting of half the maximum dose of scopolamin with about half the maximum dose of omnopon given with brandy and syrup half an hour before the birth of the head is expected. Professor Sellheim maintains that a prescription of this kind could be given by the doctor and left to be administered by the midwife just as any other sedative might be prescribed and administered. (This suggestion seems of considerable practical interest at the moment in this country, the question of universal anæsthesia in childbirth being so much to the fore.)

In the same number Dr. PAUL ROTTGER discusses the *Causes of the excitement stage in pernocton sleep.*

He believes that excitement of this kind is due to the action of the subconscious mind and differs little with different narcotics. The control of it depends on admission or due employment of suggestion beforehand, or at least when the injection is made.

In the February issue of the same journal Dr. Hans Brammer gives a long account of the use of pernokton in confinements. After trial of various combinations he has come to the practice of using pernokton only, giving first an intravenous injection (about 4 c.c.), and after at least two hours interval another injection of pernokton intramuscularly (about 2 c.c.).

Analgesia and anæsthesia in childbirth. DAME A. L. MCILROY. *Canadian Med. Ass. Journ.,* Jan., 1931.

The author states "although analgesia and anæsthesia may involve risks to the mother and child, I am firmly convinced that a considerable amount of our maternal death-rate is due to lowered resistance from excessive fatigue, shock and sepsis, the result of

witholding relief during labour. In my clinic, where for the last nine years the use of sedatives, and, when necessary, light anæsthesia for the second stage and during delivery is almost the routine method of treatment in ordinary labour cases, the patients are remarkably free from fatigue at the end of labour, and in a few hours show very little trace of their experience in the labour room. I am convinced that better results in the management of labour and in the reduction of maternal mortality will be gained by much greater attention to the relief of suffering in labour. Puerperal insanity can, to some extent, be prevented by the abolition of anxiety and suffering." An excellent discussion follows of the sedatives, chloral hydrate, opium, etc., which should be used in the early stage of labour, and the author refers to the practical question of how to arrange help for the 60 per cent of all cases in England attended by midwives.

Sodium amytal as an intravenous anæsthetic. J. C. McCann, M.D., John Fallon, M.D. *New England Journ. Med.*, Feb., 1931.

The quantity of amytal given to each patient was determined by three factors, the general condition of the patient, the rate of onset of unconsciousness, and the fall in systolic blood pressure. The maximum dose administered was 22½ grains (1.5 grms.). Young healthy adults tolerated larger doses than older debilitated ones. As a rule twice the amount of amytal was given for anæsthesia of what was needed to produce unconsciousness. The paper is based on 130 selected surgical cases. Amytal was used alone in only nine of these. Eighty per cent received additional drop ether and 10 per cent nitrous oxide. The only serious complication observed was pulmonary œdema. This occurred in four patients, three of whom died. Two of the four were elderly obese men with cardiovascular disease. One of the other two was a young man who had suffered from a lung abscess, after gas poisoning in the War. The authors believe that every past history of pulmonary suppuration contraindicates the use of amytal, and they also hesitate to give it to persons with chronic productive cough, whether from excessive conjestive smoking, heart failure, or other cause. They refer to a phenomenon similar to that met with when avertin is employed for exophthalmic cases, e.g., that patients of this kind required more amytal before sleep came, and were often conscious at the end of the operation. All the thyrotoxic patients were awake soon after their return from the operation: "It may be that with the increased oxidation characteristic of the disease there was a more rapid destruction of the drug."

Endotracheal anæsthesia with ethylene and oxygen. Gilbert Brown, M.B. *Dental Journal of Australia.*

The paper records eighty-five cases, fifty-three of which were in dental surgery. The patient is in the horizontal position until the

catheter has been passed. In order to facilitate this the throat is sprayed with 10 per cent of cocaine. Ethylene, with 10 per cent oxygen is used for inducing anæsthesia, a little ether being added after the first minute. None is required after the catheter is passed.

The advantages claimed by the method are :—

1. It is non-toxic, and has no deleterious action on bodily organs.
2. Induction is pleasant and rapid.
3. Anæsthesia may be maintained for an indefinite period.
4. Alcoholics and heavy smokers are easily handled.
5. Pulmonary disease is no contraindication.
6. Recovery is rapid and vomiting is rare.

Disadvantages mentioned are : the cost of the gases, inflammability of the mixture, and the special technique to be learned.

Explosions occurring during the use of ethylene. F. D. Johnston and Hugh Cabot. *Archives of Surgery,* February, 1931.

The authors quote authority to show that explosions do not occur in mixtures of ethylene and oxygen unless at least 40 per cent of the mixture is oxygen. In referring to an explosion in an Indiana hospital, which killed the physician working with a machine that carried tanks of oxygen, ethylene, and nitrous-oxide, they emphasize the point that mixtures of ethylene and nitrous oxide under pressure are extremely volatile. The fact that mixtures of these two gases in certain proportions may be highly explosive has not been sufficiently recognised. Above 35 per cent ethylene the mixture is not explosive, but a small amount of ethylene leaking into the nitrous oxide tank may be very dangerous. With regard to ozygen and ethylene it seems clear that at normal pressures even the most explosive concentration of ethylene will not blow up in the absence of a definite exciting cause. The article is an exhaustive one, and should be studied in detail by readers interested in ethylene. It concludes with a summary of recommendations for preventing explosions.

CORRESPONDENCE.

Tranmere, South Australia,

8th December, 1930.

To the Editor.

Dear Sir,

I should like to comment on R. J. Clausen's anæsthetic trolley described in a recent number. I think he is on the wrong track in bringing everything together in so compact a form. Gas-oxygen anæsthesia is much better dealt with by a separate well-arranged apparatus, such as a Heidbrink or McKesson. In hospitals which do not possess a lavish equipment in each theatre the gas machine may be used in one room while straight ether is administered in another.

Electric motors and their switches are dangerous things to have near ether. Sometimes ether is spilt in filling a bottle, and anyway its vapour, from any source, being heavier than air, will descend and spread round the machine. If a spark occurs there is a fire. Electricians generally say that everything is insulated and safe, but common experience proves that one is always getting shocks about electrical connections. Sparks are generally seen about electric motors, and quite big ones are apt to occur at the switches of motors in putting on and off: far more than with lights, owing to the greater load. In mines, where safety is vitally important and enforced by regulation, means are taken to minimise electric sparks by not using the current direct from the mains, but by "stepping-down" and getting a lower voltage current to work electric motors. In coal mines, I understand, the switches are air-tight, on the well-known principle of the safety lamp. Yet it is common to see the switch working the motor of suction and ether vaporising machines right alongside the ether bottle. Fires have occurred with these appliances; one at the Ade-

laide Children's Hospital just after the writer had suggested the plant described below.

At this hospital ether vapour insufflation is used a good deal in the out-patients' operating theatres. The arrangement of the anæsthetic apparatus is as follows: There are two theatres, one dark and one day-light, separated by small rooms. In one of these latter is placed the electric motor and blower on a small table against the wall—it is an American make, Israel-Carmody. From it goes the air pipe, ordinary three-eighths gas-piping, up the wall to a T bend above the ceiling, from which go pipes to each theatre, coming down from the ceiling at a convenient position towards the end of and slightly to one side of the usual position of the operating table. Each pipe ends with a tap at a convenient height; from it goes rubber tubing to the anæsthetic table on which is situated the ether bottle with accessories for either intra-tracheal or intrapharyngeal insufflation. The motor is switched on and off by a ceiling snap switch; and the cord to pull this hangs just over each anæsthetic table. The advantages claimed are: (1) There is no possible danger of ether catching fire from an electric spark (ether vapour will never reach the switch high up at the ceiling). (2) With the door shut of the room containing the motor there is not the slightest noise heard. To many people the constant whirr of an electric motor is most disagreeable. My experience is that with these motors on anæsthetic tables further vibrations are set up and bottles made to rattle. (3) The motor is in a fixed position, open and easily accessible for oiling, inspections of driving belt, etc., so that breakdowns are minimised.

Suction for tracheal-anæsthetic operations is provided by a simple appliance fitted to the water service. Thus the motor blower has only pure air passed through it, and not, as in the arrangement so often seen, the air for one patient drawn over the contents of the suction bottle and through the tubing and pump, all of them sprayed with blood and a mixed flora of organisms from the throats of previous patients. It has always been a little astounding to me that this unhygienic practice of spraying the raw area of one patient's throat with streptococci from the last patient should go on. Some of

these suction and blower apparatuses are fitted into a small filter, but in actual practice I doubt if they are often attended.

Yours faithfully,

E. Couper Black, M.B., B.S.
Honorary Anæsthetist,
Adelaide Children's Hospital,
Adelaide Hospital.

Great Charles Street,
Birmingham,
17th January, 1931.

A CORRECTION.

Dear Sir,

In my communication *re* "Percain Spinal Anæsthesia" appearing in the *British Journal of Anæsthesia* for January, I notice a serious printer's error. On page 66 is stated: "Spinal headache occurred with varying degrees of severity in the first 100 (sic) cases." This of course is absurd, as the notes were based on 80 cases only. The number should be 10 (ten).

Yours faithfully,

L. Kirkby Thomas.

Below are extracts from a letter which is too long to be inserted in its entirety. It is from Dr. R. W. Hornabrook, of Melbourne, Australia.

You will get a delightful anæsthesia with endotracheal work. There is no question on that point; and to see a man giving an endotracheal anæsthesia for, say, abdominal work, you feel inclined to take off your hat to that man. The respirations are quiet, the abdomen has no movement, and why? For this reason, that under endothracheal work there is an absolutely free airway.

Now that is the secret of all good anæsthetic work. It is not so much anæsthetic you require, as air.

* * *

In my papers I have always stressed two main points—free airway and anæsthetic sleep. Now anæsthetic sleep is certainly different from anæsthetic coma.

* * *

How many anæsthetists will insist that their patients must be induced in an absolutely comfortable position? And the absolutely comfortable position is always with the head and shoulders well raised at an angle of from 30 to 45 degrees if in the recumbent position; or if in the dental chair at anything from 45 to 75 or 80 degrees.

I am not talking from hearsay, but from experiments carried out upon myself during various forms of anæsthesia, and under varying positions.

There is also one other point, and a very important point indeed—every ray of light should be cut off from the eye, not only during induction, but also throughout the whole operation, from start to finish. This means cutting down the consumption of anæsthetic enormously.

I am not going to disagree with tracheal anæsthesia for abdominal work. In fact, I will agree to the extent that you do get a delightful anæsthesia as far as quietness of respiration and relaxation are concerned, but where I differ, and differ very strongly, is this—that you get all those conditions without resorting to endotracheal work and without, what I honestly consider, the risk or objection of introducing a foreign body into the larynx.

For instance, you might strike me quite a strong blow over the heart when I was conscious, and nothing would happen, but strike me the same blow or even a much gentler one over the heart when I am unconscious and you would kill me. In other words, in the first place I have some reserve of resistance; in the second that power of resistance is absolutely lowered, and yet how many surgeons do you see handling a patient roughly under an anæsthetic!

When will surgeons learn that every time we use an anæsthetic we are, to a more or less extent, poisoning our patient, and that it is the duty of every anæsthetist to work with the absolute minimum of anæsthetic and that to do this he must pay attention to the most minute details.

* * *

An anæsthetist who knows his job should practically never see a case of lung complications after an operation. The most common cause of lung complications after anæsthetic administration is over-doping and over-concentration of an anæsthetic during operation—in many instances caused by bad manipulation on the part of the surgeon.

Men are resorting to all sorts of fads in anæsthetic work—O cylinders and CO_2 cylinders—What for? If you want to stimulate a patient's respiration all you have to do is to place your hand over his mouth, grasp his nostrils between your thumb and forefinger, and either close, or partially close them for a quarter or half a minute, then release nostrils for about half a minute, and then close again. You will find that at once respirations are stimulated and deepened, and also the blood pressure raised.

Never under any circumstances do I give a "rush" induction. If you pass a patient from the semi-conscious stage into the fully unconscious stage in an absolutely comfortable position and without the least sign of resistance, he will pass into the surgical anæsthetic sleep stage, not only fully relaxed, but he will require an absolute minimum of anæsthetic throughout the operation. To operate in a stage of anæsthetic sleep you must have the preliminary morphia and atropine injection, or some equivalent.

Several experiments have been carried out recently upon myself at the Research Institute connected with the Melbourne Hospital. The anæsthetic used was chloroform and was chosen because I consider it the most dangerous, that is, if badly handled. The chloroform was administered to me in the sitting-up position and cardiographs were taken during induction and prolonged administration. The very interesting part is this, that in those cases in which I was passed under in an absolutely comfortable sitting or semi-reclining position there was not the least trace of any strain being thrown upon the heart when I passed from the subconscious into the surgically anæsthetised stage; but if I was not in an absolutely comfortable position prior to induction, when I passed over from the subconscious into the fully surgically anæsthetised stage I always made some movement, and it was then that the cardiograph showed that an extra strain was thrown on the heart and things were not normal.

If men would only learn to carry out all their anæsthetic work with the one big idea of producing in their patients "anæsthetic sleep" and not anæsthetic coma, and also would impress upon the surgeon that every time under operation a patient must be handled not with less care but with more care because he is under an anæsthetic than if he were not, then they would find that a lot of their "freak" methods, as I call them, would be absolutely unnecessary, and that they would not require endotracheal work for their abdominal cases.

I have not seen a case of lung complications following upon operation for over 20 years (and I follow-up all my cases, private and hospital). I am certain in my own mind that the factors for lung complications are:—

(1) Chiefly—over concentration of anæsthetic and absence of free airway during operation.

(2) Entrance of mucus or septic matter into the air passage during nose and throat operations, in many cases due to endotracheal anæsthesia.

(3) An unnecessarily deep anæsthesia during nose and throat work.

If I had my own way no anæsthetist would ever be permitted to administer an anæsthetic until he had either had one or more administered to him and had administered one or more to himself. He would learn more in half an hour that way than he will learn in a month of Sundays any other way.